

2 in Ark.; and on 1 in Ill., Iowa, Kans., Ky., Mo., and N. H. West of the Rocky Mountains thunder-storms were reported as follows: Ariz., 5th, 30th, and 31st; Cal., 3d; Nev., 29th

and 30th; Oregon, 14th and 19th; Utah, 30th; Wash., 13th and 18th. In states and territories other than those named no thunder-storms were reported.

MISCELLANEOUS PHENOMENA.

○ DROUGHT.

Drought prevailed in parts of Illinois, Iowa, Missouri, Louisiana, Texas, and Montana. At Philo, Ill., only 0.13 inch of rain had fallen from November 16th to December 31st, and water was very scarce. At Fort Madison, Iowa, the month was very dry. At Cedar Rapids, Iowa, the monthly precipitation was the smallest for December during the last 5 years; the river was quite low, and streams and wells were becoming dry. At Oregon, Mo., water was failing in streams and springs. At Hannibal, Mo., it was the driest month of the year, and the river was reported lower than at any time in 50 years. At Shelby, Mo., no precipitation fell from November 16th until December 31st, and wells and stock ponds were unusually low. The drought that prevailed in north Louisiana from November 16th was broken on the 5th, and in south Louisiana on the 3d. Near San Antonio, Tex., scarcity of water on the ranges caused large loss of live stock; the drought was broken on the 23d. Near Fort Custer, Mont., many streams were dried up, and stock was suffering for water.

○ MIRAGE.

On the 14th, at Saint Vincent, Minn., the Pembina Mountains, 50 miles distant, and Hamilton, N. Dak., 22 miles distant, were in full view at 8 a. m., 75th meridian time. At this time a remarkably fine mirage was observed. Objects, large and small, were plainly brought to view. Smoke from chimneys many miles away could be distinctly seen, and cattle in a farm-yard, 8 miles distant, were plainly visible. The phenomenon lasted from daybreak until 9.45 a. m. On the 20th a mirage was observed at Ship Island Light-house, Miss., between 3 and 4 p. m., Biloxi, Miss., and vessels and bathing-houses being clearly seen.

○ SUN SPOTS.

Mr. D. E. Hadden, Alta, Iowa: 3d, 1 group, 1 spot; large spot on nw. limb, disappearing by solar rotation. 7th, small faculae on nw. limb; faint groups faculae near e. and sw. limbs. 12th, small faculae near e. limb. 14th, 2 groups, 10 spots; larger groups s. latitude on meridian; other group e. one-fourth across disc; small faculae near se. limb. 15th, 3 groups, 14 spots, definition poor. 16th, 2 groups, definition poor. 17th, 1 group, definition poor. 18th, 2 groups, 8 spots; large group of 5 spots near sw. limb, surrounded by faculae; the other group 1 day east of meridian. 19th, 2 groups, 10 spots; new spots in group on meridian. 20th, 3 groups, 5 spots; 1 group on w. limb, disappearing by solar rotation, had brilliant faculae, but spots could not be seen; new group on e. limb with large areas of faculae. 21st, group which was near meridian n. latitude 20th had disappeared, and the group visible

on e. limb 20th could not be seen; small faculae e. 23d, faculae w. and sw. 26th, 1 group, 2 spots; new group n. latitude 1 day e. of meridian. 27th, 1 group, 1 spot; spot on meridian vanishing. 28th, small faculae by rotation on e. limb. 29th, 1 group, 1 spot; new group in faculae near e. limb; faculae nw. Cloudy 1st, 2d, 4th, 5th, 13th, 24th, and 31st.

Mr. C. E. Buzzell, Leaf River, Ill.: 1st, the large disturbance of November 21st was passing w. limb. 2d to 7th, cloudy. 8th, marked faculae and small spots near w. limb. 9th to 12th, poor definition. 13th, poor definition; 1 group, 2 days in, in n. latitude; 1 group, 5 days in, in s. latitude; both unchanged on 14th. 15th and 16th, cloudy. 18th, 1 new group near meridian; 1 group near w. limb, which faded out on 19th. Group of 18th subsided on 20th, with apparent clear disc on 21st. 25th, 2 small groups in n. latitude near meridian; faded out on 28th. 29th, new group, 3 days in, in n. latitude; faded out on 30th. 31st, cloudy.

Mr. John W. James, Riley, Ill.: the large spot on the sun's meridian November 28th disappeared by solar rotation 4th, but failed to reappear when due on e. edge. 4th to 13th, none seen. 14th, a group of 12 small spots on sun's meridian in very low s. latitude; still seen 18th. 21st, faculae near e. limb. 21st to 28th, no spots seen. 29th, 1 small spot, surrounded by faculae, 2 days from e. edge; spot gone on 30th.

Mr. H. D. Govey, North Lewisburgh, Ohio: sun spots were observed on the 2d, 14th, 15th, 18th, and 19th.

Haverford College Observatory, Pa. (observed by Prof. F. P. Leavenworth):

Date.	Number of new		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		Faculae.	Remarks.
	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.		
Dec., 1890.										
1, 10 a. m.	1	1	0	0	0	0	3	13	2	Definition fair; 2 large spots.
2, 11 a. m.	0	0	0	0	0	0	2	8	1	Definition good; 1 large spot.
4, 11 a. m.	0	0	1	3	0	0	0	0	2	Definition fair.
9, 2 p. m.	1	4	0	0	0	0	1	4	1	Definition good.
10, 10 a. m.	1	3	1	4	0	0	1	3	1	Definition good; spots small.
11, 11 a. m.	0	0	0	0	0	0	1	2	1	Definition good; spots small.
12, 11 a. m.	0	0	0	0	0	0	0	0	0	Definition poor.
13, 11 a. m.	2	15	0	0	0	0	2	15	2	Definition fair.
14, 12 m.	0	17	0	0	0	0	2	32	1	Definition fair.
15, 9 a. m.	0	0	0	0	0	0	2	32	2	Definition fair.
18, 3 p. m.	0	0	0	0	0	0	2	21	0	Definition bad.
19, 10 a. m.	1	1	0	0	1	17	3	24	2	Definition poor; 1 large spot.
20, 1 p. m.	0	19	0	0	0	0	3	31	2	Definition good.
22, 10 a. m.	0	0	1	4	0	0	0	0	1	Definition fair.
23, 10 a. m.	1	2	0	0	0	0	1	2	2	Definition poor.
24, 10 a. m.	0	4	0	0	0	0	1	6	2	Definition poor.

○ VERIFICATIONS.

[Verifications made by Assistant Professor C. F. Marvin, assisted by Mr. H. E. Williams, chief clerk of the Forecast Division.]

○ FORECASTS FOR 48 AND 72 HOURS IN ADVANCE.

Appreciating the great importance that long time predictions possess for the general public the Chief Signal Officer has authorized forecasts for 48 and 72 hours, covering the 2d and 3d days in advance. These are optional with the forecast official, and are only made when clearly in the public interest, and cover, in all cases, considerable areas of country, and are not confined to localities.

Percentages of verifications of forecasts made for second day in advance. Number of predictions made: weather, 243; temperature, 158. Percentages of verifications: weather, 84.1; temperature, 94.4; weather and temperature combined, 87.5.

Percentages of verifications of forecasts made for third day in advance. Number of predictions made: weather, 25. Percentage of verifications: weather, 96.

○ FORECASTS FOR 24 HOURS IN ADVANCE.

The forecasts for districts east of the Rocky Mountains for December, 1890, were made by Captain James Allen, 3d Cav-

alry, Signal Officer, and those for the Pacific coast districts were made at San Francisco, Cal., by 2d Lieutenant John P. Finley, Signal Corps.

Percentages of forecasts verified, December, 1890.

States.		States.	
Maine.....	81.9	Kentucky.....	84.6
New Hampshire.....	84.2	Ohio.....	81.4
Vermont.....	86.1	West Virginia.....	85.4
Massachusetts.....	79.9	Indiana.....	79.2
Rhode Island.....	83.2	Illinois.....	88.4
Connecticut.....	83.2	Lower Michigan.....	74.9
Eastern New York.....	84.8	Upper Michigan.....	72.6
Western New York.....	74.3	Wisconsin.....	84.4
Eastern Pennsylvania.....	83.8	Minnesota.....	88.8
Western Pennsylvania.....	79.4	Iowa.....	86.6
New Jersey.....	85.3	Kansas.....	86.1
Delaware.....	86.7	Nebraska.....	82.8
Maryland.....	86.7	Missouri.....	84.5
District of Columbia.....	87.0	Colorado.....	84.3
Virginia.....	85.5	North Dakota.....	86.6
North Carolina.....	84.3	South Dakota.....	85.0
South Carolina.....	81.4	Southern California*.....	90.9
Georgia.....	81.9	Northern California*.....	89.1
Eastern Florida.....	85.7	Oregon*.....	86.8
Western Florida.....	84.1	Washington*.....	85.0
Alabama.....	91.4	By elements: Weather.....	85.7
Mississippi.....	91.5	Temperature†.....	81.2
Louisiana.....	89.7	Monthly percentage of weather and	
Texas.....	82.8	temperature combined‡.....	83.9
Arkansas.....	79.5		
Tennessee.....	82.2		

* In determining the monthly percentage of weather and temperature combined, the Pacific coast states are not included. † The forecasts of temperature in districts east of the Rocky Mountains for December, 1890, were made with reference to the maximum temperature alone; that is, a prediction of warmer or cooler indicated that the maximum temperature of the day designated would be higher or lower than the maximum of the previous day. ‡ The monthly percentage of weather and temperature combined is determined by multiplying the percentage of weather by 6, and the percentage of temperature by 4, and dividing their sum by 10.

WIND SIGNALS FOR DECEMBER, 1890.

Statement showing percentages of justifications of wind signals for the month of December, 1890:

Wind signals.—(Ordered by Captain James Allen.) Total number of signals ordered, 95; justified as to velocity, wholly, 70, partly, 12; justified as to direction, 93. Of the signals ordered 49 were cautionary, of which 33 were wholly and 7 partly justified; and 46 were storm signals, of which 37 were wholly and 5 partly justified. 20 signals were ordered for easterly winds, of which 18 were justified, and 75 were ordered for westerly winds, all of which were justified. Percentage of justifications, 77.5.

COLD-WAVE SIGNALS AND TEMPERATURE-FALL WARNINGS.

[Ordered by Assistant Professor T. Russell.]

Number of cold-wave signals ordered, 156; justified, 102. Percentage of justifications, 65.4. Number of temperature-fall warnings, 119. Percentage of justifications, 61.3. Percentage of justifications of cold-wave signals and temperature-fall warnings combined, 64.3.

Percentages of verifications of weather and temperature signals reported by directors of the various State Weather Services for December, 1890.

States.	Weather.	Temperature.	States.	Weather.	Temperature.
Iowa.....	92	93	Nebraska.....	87	86
Illinois.....	87	85	New Jersey.....	83	87
Michigan.....	88	88	North and South Dakota.....	82	82
Minnesota.....	79	85	Ohio.....	88	88
Missouri.....	84	85	Pennsylvania.....	82	84

STATE WEATHER SERVICES.

[Temperature in degrees Fahrenheit; precipitation, including melted snow, in inches and hundredths.]

The following extracts and summaries are republished from reports for December, 1890, of the directors of the various state weather services:

ALABAMA.

Temperature.—Maximum, 91, at Brewton, 5th; minimum, 20, at Valley Head, 4th, 28th, and 29th, and at Citronelle, 9th; greatest monthly range, 68, at Brewton; least monthly range, 39, at Chattanooga, Tenn.

Precipitation.—Greatest monthly, 3.97, at Double Springs; least monthly, 1.35, at Bermuda.

Wind.—Prevailing direction, northwest.—Prof. P. H. Mell, Auburn, director; J. M. Quarles, Private, Signal Corps, assistant.

ARKANSAS.

Temperature.—The mean was 2.1 above the normal; maximum, 78, at Texarkana, 24th; minimum, 2, at Lead Hill, 9th; greatest monthly range, 74, at Lead Hill; least monthly range, 44, at Conway and Dallas.

Precipitation.—The average was about 1.26 below the normal; greatest monthly, 5.12, at Winslow; least monthly, 1.70, at Texarkana.

Wind.—Prevailing direction, north.—M. F. Locke, Commissioner of Agriculture, Little Rock, director; F. H. Clarke, Sergeant, Signal Corps, assistant.

COLORADO.

Temperature.—Maximum, 87, at Bennet, 10th; minimum, —21, at Breckenridge, 8th; greatest monthly range, 93, at Breckenridge; least monthly range, 30, at Monte Vista.

Precipitation.—Greatest monthly, 5.40, at Cumbres; least monthly, 0.00, at several stations.—W. S. Miller, Sergeant, Signal Corps, Denver, assistant.

ILLINOIS.

Temperature.—The mean was 3.0 above the normal; maximum, 63, at Cairo, 1st; minimum, —2, at Aurora, Belvidere, and Sycamore, 4th.

Precipitation.—The average was 1.78 below the normal; greatest monthly, 2.91, at Cairo; least monthly, 0.03, at Keokuk, Iowa.

Wind.—Prevailing direction, northwest.—John Craig, Sergeant, Signal Corps, Springfield, in charge.

INDIANA.

Temperature.—Maximum, 69, at Jeffersonville, 21st; minimum, 2, at Maury and Point Isabel, 28th; greatest monthly range, 62, at Princeton and Warrington; least monthly range, 82, at Columbia City.

Precipitation.—Greatest monthly, 3.86, at Cannelton; least monthly, 0.23, at La Fayette.

Wind.—Prevailing direction, southwest.—Prof. H. A. Huston, La Fayette, director; C. F. R. Wappenhans, Sergeant, Signal Corps, assistant.

IOWA WEATHER AND CROP SERVICE.

Temperature.—The mean was 6.5 above the normal; maximum, 72, at Glenwood, 10th; minimum, —18, at West Bend, 8th; greatest monthly range, 80, at Eagle Grove; least monthly range, 42, at Fort Madison.

Precipitation.—The average was about 1.00 below the normal; greatest monthly, 1.40, at West Bend; least monthly, 0.00, at Logan and Glenwood.

Wind.—Prevailing direction, northwest.—J. R. Sage, Des Moines, director; G. M. Chappel, Sergeant, Signal Corps, assistant.

KANSAS.

Temperature.—The mean was about 5.0 above the normal; maximum, 82, at Horton, 22d; minimum, —3, at Lakin, 7th; greatest monthly range, 74, at Horton; least monthly range, 48, at Morse.

Precipitation.—The average was 0.52 below the normal; greatest monthly, 2.00, at Oswego; least monthly, 0.00, at several stations.

Wind.—Prevailing direction, southwest.—Prof. J. T. Lovewell, Topeka, director; T. B. Jennings, Sergeant, Signal Corps, assistant.

KENTUCKY.

Temperature.—The mean was less than 1 above the normal; maximum, 70, at Earlington, 1st; minimum, 12, at Shelbyville and Richmond, 28th; greatest monthly range, 50, at Frankfort and Princeton; least monthly range, 38, at Central City and Franklin.

Precipitation.—The average was about 1.00 below the normal; greatest monthly, 4.27, at Franklin; least monthly, 2.14, at Mount Sterling.

Wind.—Prevailing direction, southwest.—Dr. E. A. Grant, Louisville, director; Frank Burke, Sergeant, Signal Corps, assistant.

LOUISIANA.

Temperature.—Maximum, 82, at Melville, 7th, and at Plaquemine, Cameron, and Thibodeaux, 6th; minimum, 21, at Liberty Hill, 9th; greatest monthly range, 58, at Plaquemine; least monthly range, 37, at Port Eads.

Precipitation.—Greatest monthly, 6.08, at Amite City; least monthly, 1.07, at New Iberia.

Wind.—Prevailing direction, north.—George E. Hunt, Sergeant, Signal Corps, New Orleans, in charge.

MICHIGAN.

Temperature.—The mean was 1.6 below the normal of the last 15 years; maximum, 55, at Hanover 1st, and at Grape, 10th; minimum, —17, at Hillman, 7th; greatest monthly range, 62, at Hillman; least monthly range, 28, at Colon.